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# ALTERNATIVE METHODOLOGIES FOR THE ESTIMATION OF LOCAL POINT DENSITY INDEX: MOVING TOWARDS ADAPTIVE LIDAR DATA PROCESSING

Z. Lari and A. Habib
Dept. of Geomatic Engineering, University of Calgary, 2500 University Drive N.W., Calgary, AB, T2N1N4, Canada

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Abstract. Over the past few years, LiDAR systems have been established as a leading technology for the acquisition of high density point clouds over physical surfaces. These point clouds will be processed for the extraction of geo-spatial information. Local point density is one of the most important properties of the point cloud that highly affects the performance of data processing techniques and the quality of extracted information from these data. Therefore, it is necessary to define a standard methodology for the estimation of local point density indices to be considered for the precise processing of LiDAR data. Current definitions of local point density indices, which only consider the 2D neighbourhood of individual points, are not appropriate for 3D LiDAR data and cannot be applied for laser scans from different platforms. In order to resolve the drawbacks of these methods, this paper proposes several approaches for the estimation of the local point density index which take the 3D relationship among the points and the physical properties of the surfaces they belong to into account. In the simplest approach, an approximate value of the local point density for each point is defined while considering the 3D relationship among the points. In the other approaches, the local point density is estimated by considering the 3D neighbourhood of the point in question and the physical properties of the surface which encloses this point. The physical properties of the surfaces enclosing the LiDAR points are assessed through eigen-value analysis of the 3D neighbourhood of individual points and adaptive cylinder methods. This paper will discuss these approaches and highlight their impact on various LiDAR data processing activities (i.e., neighbourhood definition, region growing, segmentation, boundary detection, and classification). Experimental results from airborne and terrestrial LiDAR data verify the efficacy of considering local point density variation for precise LiDAR data processing.v

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